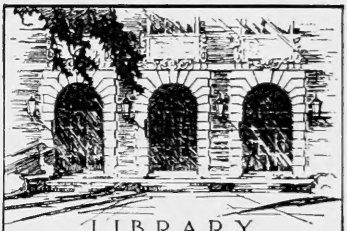

Outwitting Termites *in Illinois*

W. E. McCauley
W. P. Flint

Illinois Natural History Survey

Circular 37

STATE OF ILLINOIS
HENRY HORNER, *Governor*
DEPARTMENT OF REGISTRATION AND EDUCATION
JOHN J. HALLIHAN, *Director*

Outwitting Termites

in Illinois

W. E. McCAULEY
W. P. FLINT

Printed by Authority of the State of Illinois

NATURAL HISTORY SURVEY DIVISION
THEODORE H. FRISON, *Chief*

Circular 37 Urbana April 1940

This paper is a contribution from the Section of Economic Entomology

(A17665—6M—3-40)

CONTENTS

The ideal time to make a home termite proof is during the process of construction.

The home that is built to discourage termite attack saves its owner worry, time and money.

OUTWITTING TERMITES
in Illinois

W. E. McCauley *and* W. P. Flint*

TERMITES may seriously damage a building in 6 months, or they may live in it for 6 years or more without much damage. What they do depends on the measures taken to control them, on the material in and the construction of the building, on the surroundings and on the vigor of the termite colony.

Termites are progressively more common from the northern to the southern counties of Illinois. They are very abundant in all sections of the southern half of the state.

These insects are not new in Illinois; evidence indicates that they were here when the Indians roamed the prairies. At that time termites were not infesting homes, to be sure, but were present in their native habitat, the woodlands. They fed on an abundant supply of dead wood without complaint from anyone. As the woodlands were cleared and the natural source of food became reduced, termites attacked the wood in human dwellings that were built.

In bringing civilization to Illinois, man encouraged rather than hindered the spread and activity of termites. In areas where wood was at one time relatively scarce and where, for this reason, very little natural termite food was available, man built wooden structures, close together and row on row. Then he installed a centralized heating plant in many of his buildings so that the termites, once established, enjoyed the comforts of summer the year around and were thereby enabled to increase the amount of their damage.

This circular gives precautions that builders, contractors and householders should take to prevent termite infestation. It also gives simple directions for cleaning out infestations that are established. The most economical way to fight termites is to avoid having them. This can be done by taking a few simple precautions in the construction of buildings. Certainly all new

*The authors wish to express their appreciation to Dr. Carl O. Mohr and Mr. R. E. Favreau for making the drawings contained in this circular. They wish also to express thanks to Mr. H. L. White, Sanitary Engineer, University of Illinois, for use of photographs and for helpful suggestions.

homes should be built to reduce the possibility of termite attack. Well-established infestations may require treatment by pest control operators.

TERMITES AND THEIR HABITS

What are termites?—Termites are social insects; that is, they live together in a colony or community of several colonies in which there is a great degree of specialization. The well-established colony is composed chiefly of adult workers and imma-

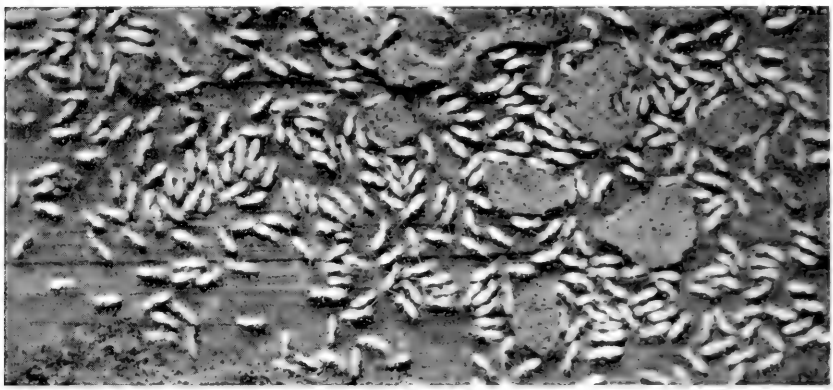

Fig. 1. —**Termites at work in an infested board. Most of the termites visible are the workers or destructive members of the colony.**

ture individuals of several castes; the latter appear very similar to the workers. Most of the termites seen when a colony is disturbed look like dirty white maggots with legs, fig. 1 and fig. 2B.

The workers are the destructive members of the colony, having chewing mouth parts with which they attack wood and wood products. They build the termite galleries or termite sheds characteristic of these insects. They care for the reproductives, the eggs, the very young and the soldiers, their duties being many and complex. Besides the workers, a well-established colony of our Illinois termites contains soldiers and usually two and occasionally three forms of reproductives.

The soldiers are probably the least important members in the colony. They attempt to protect the colony when a break occurs in its outside walls, but they are actually rather helpless against even a relatively small enemy. Nevertheless, several soldiers may, with their heads, successfully block a small break in a wall until repairs can be made by the workers.

The reproductives, or kings and queens, are very important

members of the society. They occur in one of three forms, the most common form being the black, winged individuals commonly called "flying ants," often seen emerging from infested wood. Usually, throughout Illinois, termite swarms occur in the spring. The earliest swarms emerge within heated buildings,

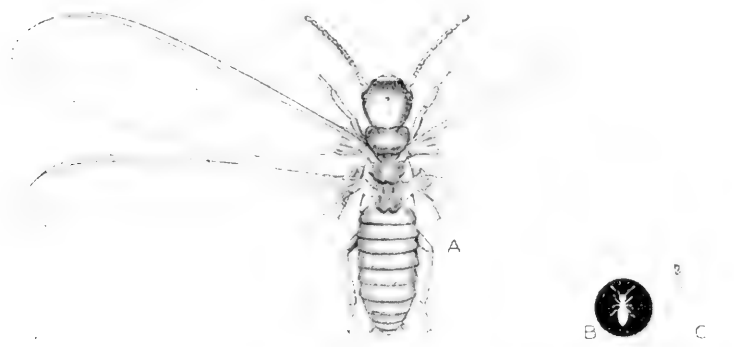

Fig. 2.—The kind of termite found in Illinois, *Reticulitermes flavipes* (Kollar). A. First form queen, many times natural size. B. Worker nymph, natural size. C. First form queen, natural size, with wings in normal resting position.

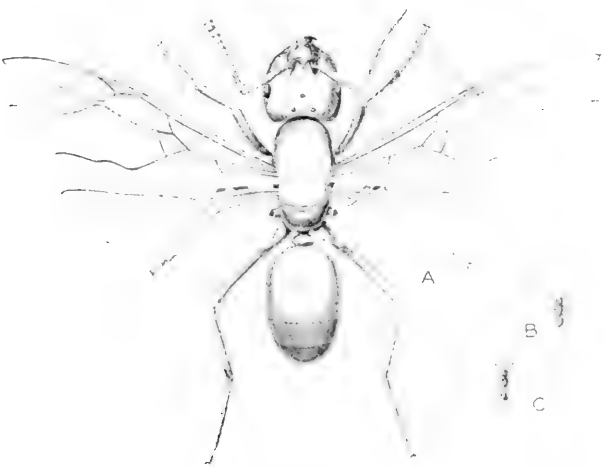

Fig. 3. A harmless winged ant, the yellow ant, *Lasius interjectus* Mayr, with which the winged termite is often confused. A. Queen, many times natural size. B. Worker ant, natural size. C. Queen, natural size, with wings partially closed and as usually seen. The ant has a narrower waist and shorter wings than the termite.

most often during February. The later swarms emerge out of doors during late May or early June in the northern part of the state, and earlier in the southern part.

Since it is important to distinguish winged termites from the harmless winged ants, the two insects are contrasted here. As shown in figs. 2 and 3 these insects differ conspicuously. The wings of the termite, nearly uniform in length, are in sharp contrast with the long forewings and the short hindwings of the ant. The relative length of the wings of each may be compared with the length of the hind portion of the body; the wings of the termite are almost twice as long, while the wings of the ant are but little longer than the hind part of the body. Then, too, there is considerable difference in the shape of the body; the body of the termite is almost uniform in width while that of the ant narrows sharply between the fore and hind parts.

How do termites reproduce? Each mating pair of the winged termites or "swarmers," as they are sometimes called, is capable of starting a new colony. However, most of these "swarmers" fall prey to birds, toads or other natural enemies, and still others fail to locate suitable nest sites and subsequently perish; but a few fortunate pairs locate a suitable place, and each couple dig a little cell into which they crawl after breaking off their wings. Mating follows shortly thereafter and the queen, as the female is usually called, soon begins laying eggs.

During the first year, only a few eggs are laid, as the king and queen must do all the work connected with maintaining the colony as well as raising the young. After the first year, reproduction gains in momentum very rapidly, the workers raised the first year taking over the duties of the colony. By the end of the third year the colony may be producing thousands of termites annually. Some of these are winged reproductives which swarm and fly away to start other colonies.

Besides these winged reproductives there are, in most well-established colonies, wingless individuals which carry on reproduction activities much as do the first form or original pair which established the colony. Thus, the life of the colony is almost guaranteed in that the parent king and queen may be destroyed without weakening very much the reproductive powers of the colony. Wingless reproductives not needed in the colony to supplement or replace the king and queen crawl away some distance and establish branches of the original centralized colony. Thus, instead of a colony as we think of it in relation to

Fig. 4.—Very large termite tubes that extend through a poorly constructed concrete floor and over the concrete wall of a basement.

Fig. 5.—Termite tubes extending out over concrete from the wooden frame of a basement window, the lower part of which is close to the ground.

Fig. 6.—Termite tube built up on the outside of the concrete foundation of a house. This tube is small and rather difficult to detect. The foundation must be carefully examined to locate such inconspicuous tubes.

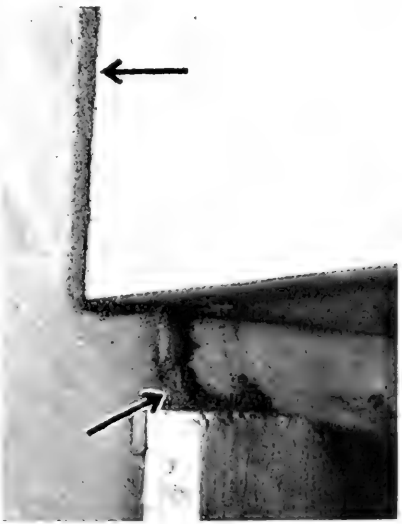

Fig. 7.—Termite tube extending from a wooden door frame up over the outside of a concrete beam to the wood timbers of a house. The figure does not show the wood above the concrete beam to which the termite tube leads.

ants or bees, we have in the case of the termites a whole community. Since the progeny of these wingless reproductives never have wings, buildings may be infested without a swarm of the winged reproductives ever appearing on the surface.

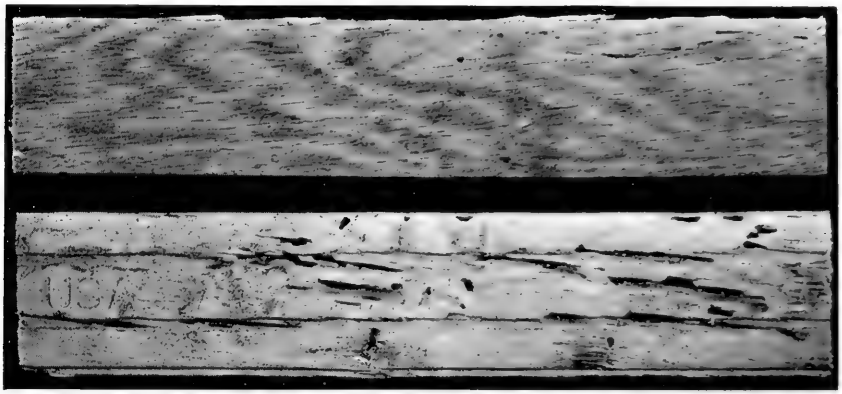

Fig. 8.—Oak flooring damaged by termites. The top view shows the varnished surface of the flooring. The lower view shows the concealed damage done by termites to the same board. This example illustrates the difficulty of detecting termite damage on exposed surfaces. Not infrequently entire boards are destroyed except for the very thin exterior layer of wood.

It is not uncommon for an old, established colony temporarily to cease sending out swarmers as a result of the loss of its original queen. This occurrence may explain why some buildings are incorrectly thought to be free of termites simply because swarming has ceased.

Although it is good practice to destroy the swarming termites, their destruction does not reduce the power of the colony to continue to damage infested property.

Where do termites live?—Termites such as occur in Illinois live usually beneath the surface of the soil; hence, the name subterranean termites. The scientific name of the only important species in Illinois is *Reticulitermes flavipes* (Kollar). These termites may be found underground to depths of 5 feet, feeding on plant products which are present. On the other hand, they may sometimes be found a considerable distance above the ground, the workers foraging 100 feet or more.

Since the soft-bodied termites are not able to withstand drying effects of the atmosphere, they never occur in the open, but, instead, they build elaborate tubes and galleries which they use as passageways, figs. 4, 5, 6 and 7. They almost always

feed on material in such a way that the exterior is left intact; thus, serious damage often occurs without external evidence of termite activity, fig. 8. Since termites work mostly under cover, it is important to know telltale signs of their presence. Semi-annual inspections of susceptible property should be made to guard against serious damage. (See cover.)

How may termites be detected?—Examinations of wood which rests on or near the ground may reveal the workers. Unpainted yellow pine stakes may be driven in the ground about a building to check for the presence of termites. If the insects are abundant in the vicinity, they will attack the stakes within a period of about 60 days. Although termites may occur in the soil about a building without infesting the structure itself, if they are found close to a building the owner should be alert for signs of their attack.

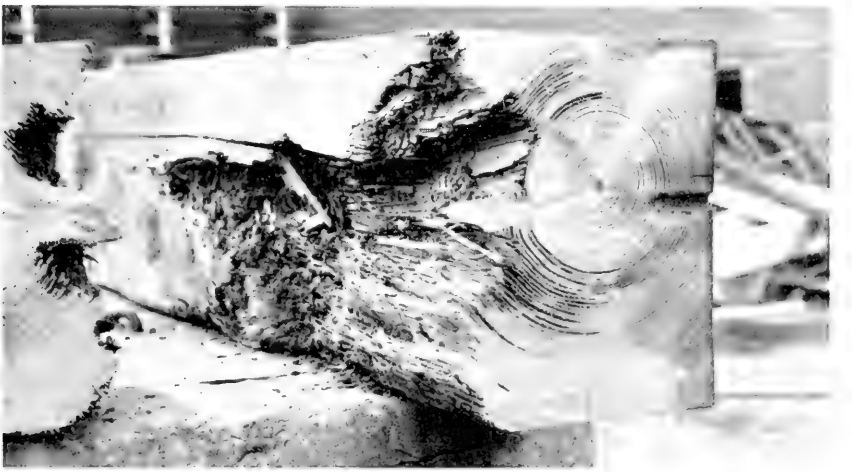

Fig. 9.—Termite injury to the frame of a large school building. In this case, before presence of termites was discovered, the entire sill had been honeycombed and largely destroyed by the insects, which had built their tunnels in it.

Wood which is near the ground, as that in cellar window frames, steps, lattices or supporting timbers, may be checked for soundness by being tapped or probed with an ice pick or screw driver. If the wood is found to be hollow, termites may be suspected.

The inside of termite tunnels is covered with dull, clay-like plaster spots. These tunnels, fig. 9, are not filled with frass or wood powder, as are the tunnels of powder post beetles and

other wood-boring insects. Nor does the exterior of wood attacked by termites contain small, round holes, as does the exterior of wood attacked by powder post beetles, fig. 10.

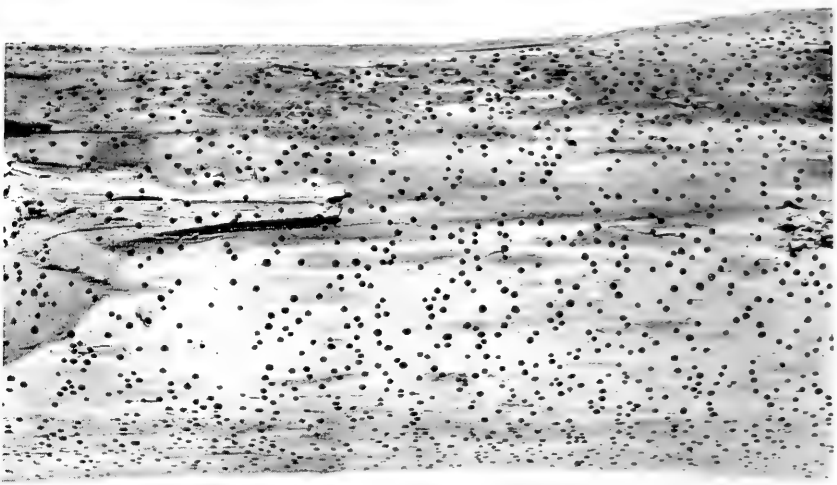

Fig. 10. Appearance of wood damaged by powder post beetles. The small holes are typical of damage by these insects, each hole representing an emergence opening of an adult beetle. Often small bits of powdered wood are found beneath timbers infested with these insects, which should not be confused with termites.

Where wood which does not rest on the ground has been attacked by termites, brown shelter tubes may be found connecting the wood with the soil. These may also be found over foundation or other walls, either inside or outside, figs. 4, 5, 6 and 7, over piers and sometimes on the surface of the wood.

Besides the above-mentioned signs of termite activity, the occurrence of the swarm already discussed is an indication that a colony is present, but, as stated before, termites may be present without the occurrence of the swarm.

It is sometimes difficult to locate termite damage, especially where the insects can penetrate foundations in such a way that they are able to build tubes up to the wood through the wall without being in evidence on wall surfaces. Since termites usually favor the inside of foundations for building their tubes, these surfaces should be accessible for frequent inspection.

How do termites enter buildings? Termites enter buildings (1) through wood which is directly on or in the ground, (2) through shelter tubes which they construct in cracks or crevices

in masonry (foundation voids), fig. 17, or (3) through tubes built over the surface of any material which reaches from the soil to the wood, figs. 4, 5, 6 and 7. Thus, it is obvious that control of termites is chiefly a matter of breaking their soil connections and keeping them broken.

How may termites be controlled? In all recommendations for termite control, people of two different classes should be kept in mind: (1) those who have buildings which are known to be infested yet who do not feel financially able to meet the cost of sufficient alteration to insure permanently against future termite attack and (2) those who are planning to erect new buildings or to alter old ones in such a way that the structures will be termite proof. Since structural control of termites constitutes the only permanent and usually the most economical way to prevent damage by them, this method will be discussed first.

STRUCTURAL CONTROL OF TERMITES

Primary measures.—Structural methods for preventing termite attack on buildings are based upon the fact that Illinois termites must have contact with the soil or other source of moisture. Any method that will break or prevent the contact of the termites with the soil or other source of moisture will avert future damage. Methods are as important as materials in accomplishing this purpose. Careful attention must be given to detail, as a slight defect or oversight may result in failure.

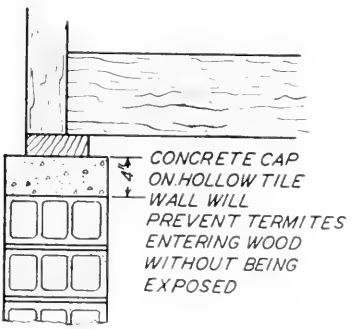

Fig. 11.—Passage of termites through or between hollow unit masonry foundation into wood sills above may be prevented by capping such a wall with 4 inches of good concrete. The termites may build tubes over this concrete, but, when they do this, their presence is easily detected by thorough inspection.

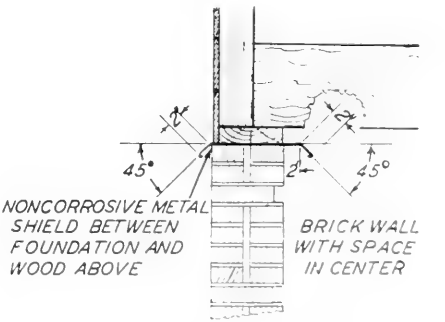

Fig. 12.—A metal termite shield correctly placed over the top of a brick foundation wall. This prevents termites from entering wood above. Special attention should be given to the 45 degree angle at which the shield is bent down. The crimped edge is not essential but aids in strengthening the shield.

1.—Building sites should be cleared of all old wood whether it be tree roots, stumps, posts or debris. Any evidence of termites should be noted and treatment made if live termites are found.

2.—Foundations of concrete should be reinforced with steel rods at points of stress to prevent cracking.

3.—Foundations of stone, brick or hollow unit masonry should be laid with cement mortar, care being taken that all joints are filled with this mortar. Such walls should be capped with 4 inches of cement mortar, fig. 11, unless shields, fig. 12, are used.

4.—All forms and other waste wood should be removed before grading in is done around the foundation. The covering of waste wood or refuse in filling or back-filling about foundation walls should be avoided, figs. 17 and 19.

5.—Cellar hatchways should be of solid concrete and, if possible, built as an integral part of the foundation to prevent cracks. If these hatchways are built separately, they should be isolated from the building by use of metal shielding.

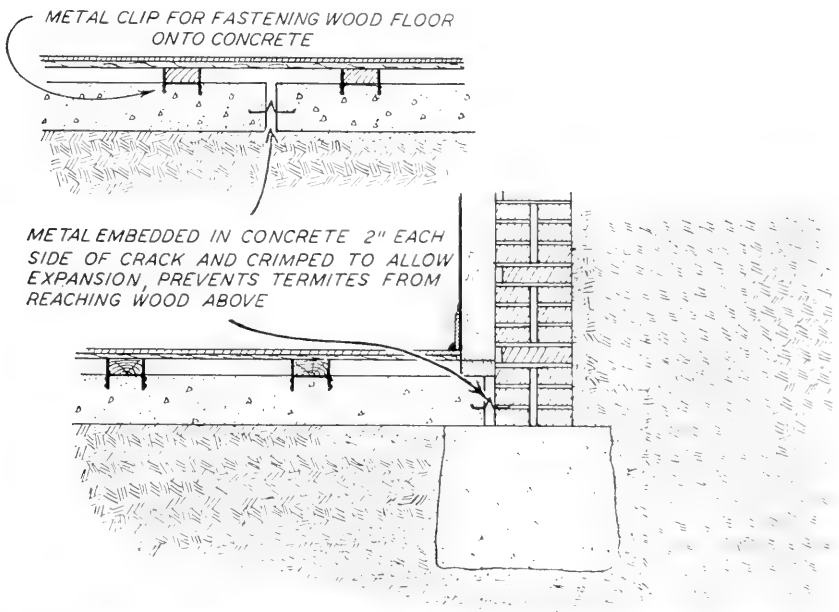

Fig. 13. Metal expansion joints installed to prevent entry of termites in union between concrete floor and wall and between two sections of concrete floor. Many modern buildings are infested through these unprotected points. The sleepers are held by metal clips instead of being embedded in the concrete, as is usual. An alternative type of joint is shown in fig. 14.

6.—Cellar windows should have metal or pressure-treated wood frames. Airways should be free of trash. (See cover.)

7.—Pipes should be set in a collar packed with coal tar pitch or other repellent material where they pass through basement floors or walls. They should be so located that inspection for termite galleries can be made without difficulty.

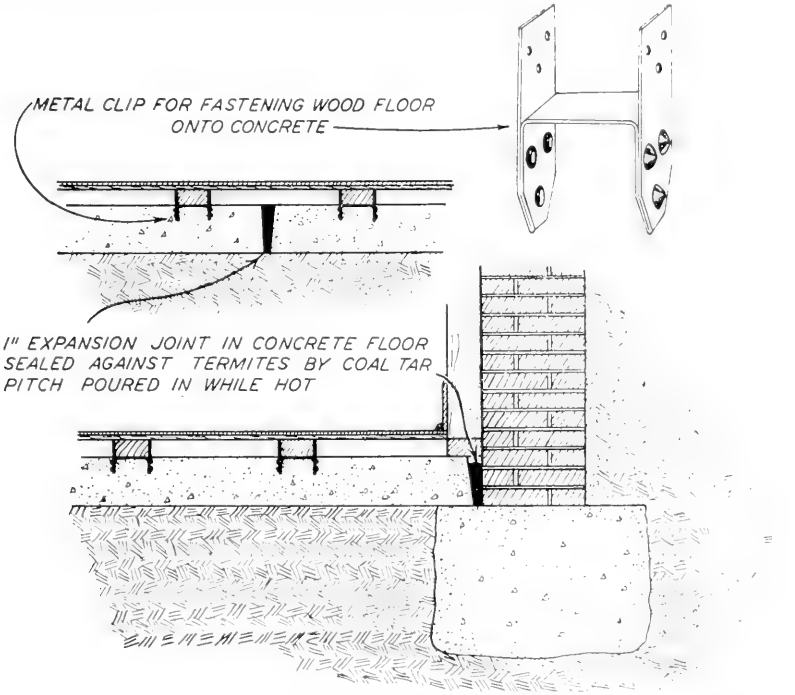

Fig. 14.—Expansion joints between sections of concrete and between concrete and masonry wall sealed against termite entry with hot coal tar pitch. This type of seal is very simple yet effective in protecting a building at a common point of termite entry. The clip illustrated is one of many types manufactured for the purpose of fastening sleepers to concrete floors, thereby eliminating the older method of embedding these timbers in concrete. An alternative type of joint is shown in fig. 13.

8.—Basement floors should be reinforced to prevent cracking. All joints in the concrete or between the concrete floor and masonry side walls should be sealed by the use of a non-corrosive metal expansion joint, fig. 13, or with repellent coal tar pitch, as shown in fig. 14. Failure to seal these joints results in thousands of infested homes every year.

9.—Concrete supports for basement partitions should be built at least 4 inches above the floor level, and all cracks or joints should be sealed as suggested above.

10.—The use of wood in basement construction should be avoided as much as possible. Wood should never extend through or into concrete or masonry floors, fig. 14. Built-in shelving or cupboards should not be joined to the floor above.

11.—Where it is necessary to lay wood floors on concrete, all grade stakes should be removed when concrete is poured. All sleepers should be of treated wood. They should not be embedded in the concrete but fastened with metal clips, figs. 13 and 14. Preferably the rough flooring also should be of treated wood.

12.—Wood steps should rest on solid concrete which projects at least 4 inches above the soil line, to allow inspection for termites. The steps should be separated from the rest of the building by a metal shield, fig. 15. Lattices should be hung from

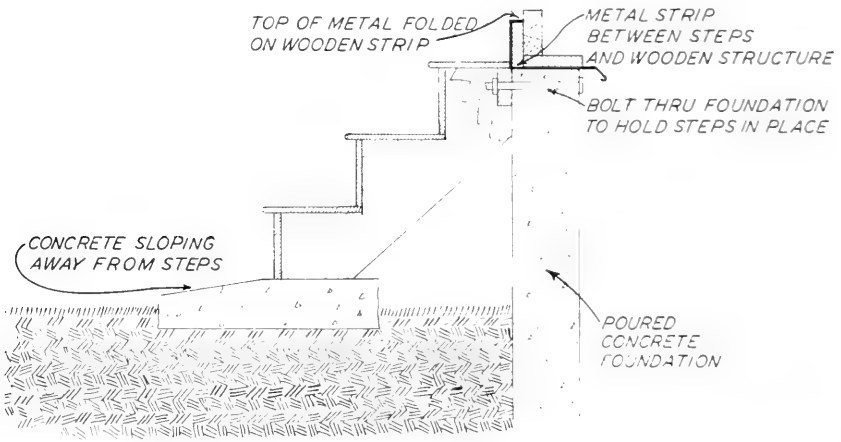

Fig. 15. A satisfactory method of installing wood steps to minimize the danger from termite attack. The steps do not contact the soil or the building.

above, and they should swing clear of soil and piers at least 2 inches, fig. 16.

13.—Wood used on or below the grade line should be isolated from soil by metal flashings (shields), the ends of which should be clearly visible for inspection, fig. 18. This precaution is highly important in veneer construction with sills on or near the grade line.

14.—Ends of joists or girders should never project into concrete walls unless ventilation is provided. They may be hung in metal stirrups or rested on masonry bearing surfaces.

15.—Ventilation should be provided beneath unexcavated portions of buildings. Sufficient clearance and entrance open-

ing should be provided to make inspection possible. Openings in the foundation should be screened with 16-mesh copper wire to prevent entrance of insects or animals.

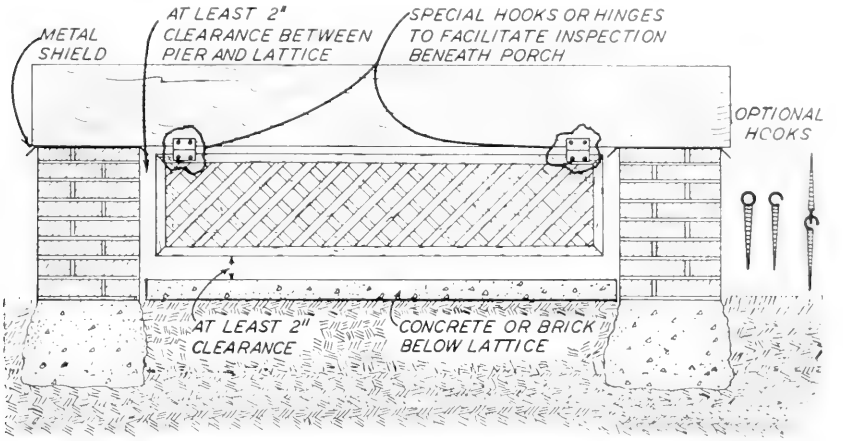

Fig. 16.—Recommended method of attaching porch lattice, which should hang on hinges to facilitate frequent inspection. Optional hooks shown may be used to allow easy removal of lattice. A clearance of at least 2 inches at sides and bottom is provided to prevent possible entry of termites from soil or piers.

16.—Provision should be made for inspection twice a year of *both* sides of basement and foundation walls.

a.—These walls should be so constructed that, to reach the wood, termites must build their galleries in exposed places. The walls may be built solidly or capped with concrete, fig. 11, or metal shields may be used, fig. 12.

b.—Plants should not be allowed to grow so close to the foundation that ventilation is prevented or inspection made impossible.

17.—A thorough inspection with the aid of a good light should be made at least twice annually; more often if termites are known to be present. (See cover.) Any termites discovered should be destroyed by application of chemicals.

Supplementary measures.—Termite resistant construction is the logical, the most economical and the only enduring method of combating these insects. Nevertheless, there is a need for supplementary methods of termite control especially suited to buildings which are infested with termites and which are not of sufficient value to warrant the spending of funds for reconstruction.

Some chemical measures may need to be used as a supple-

ment to structural methods, figs. 17 and 18. For example, it is advisable to destroy termite colonies whenever they are found near buildings or about building sites. It is wise to destroy

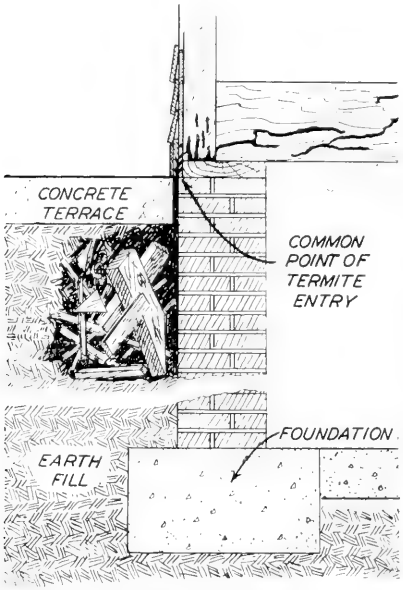

Fig. 17.—Earth-filled terraces provide a common source of termite attack. Waste wood covered with soil and kept moist by water seeping through a crack at point of union with foundation makes an ideal condition for termites, which attack the superstructure through the same crack as that which supplies the moisture. Conditions shown here should be contrasted with those in fig. 18.

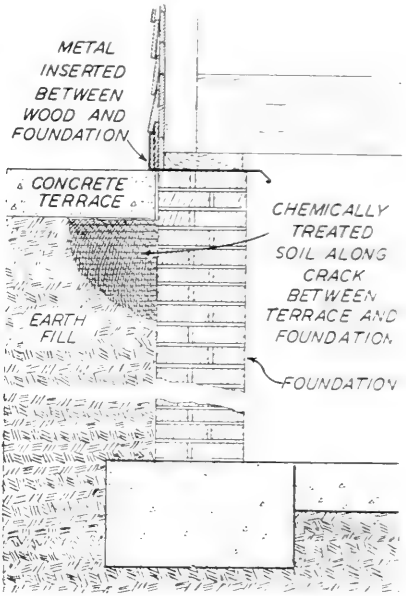

Fig. 18.—Earth-filled terrace as illustrated in fig. 17 except that the waste wood has been removed, the termite colony has been treated chemically through a hole in the terrace, with materials suggested in the text, and the superstructure has been protected with a metal guard. New terraces of this type should not cover unprotected wood where they meet the main structure.

termite colonies beneath or about a building even though it is termite resistant through its original construction or through structural alterations that have been made. Such destruction may prevent the spread of termites to near-by structures.

CONTROL OF TERMITES WITH CHEMICALS

Two methods of utilizing chemicals. -There are two distinct ways of using chemicals in destroying subterranean termites or preventing their attack: (1) Impregnation of wood with repellent or toxic chemicals to prevent termite attack, and also check decay, a process known as wood preservation, is the older application, such procedure having been a well-established prac-

tice before the close of the nineteenth century; (2) a much newer development is the application of chemicals to foundation cracks and voids, or to the soil beneath and contiguous with the foundation, to destroy and prevent termite attack on the building. This latter process, coupled with certain fundamental structural alterations, offers the simplest and most practical method of handling termites in a great many infested buildings. It is this phase of termite control that will be discussed most thoroughly in the following paragraphs.

Wood preservation. The matter of wood preservation has been well developed in several good publications of the U. S. Forest Products Laboratory at Madison, Wis., where the work of one division of that institution is devoted to investigation of this subject. It is felt that the following statements relative to wood preservation, based upon conclusions of that laboratory, will be of help here. Since the effectiveness of wood treatments is usually in direct proportion to the amount of chemical taken up by the wood it follows that, where wood must be depended upon to withstand the attack of termites or the growth of fungi, only commercially pressure-treated wood should be used. Such wood may be purchased from lumber yards throughout the United States. The Illinois Lumber and Material Dealers Association, Inc.,* should be able to give information on the availability of such lumber.

It has long been the practice of carpenters making repairs, where termites or decay have destroyed a timber, to brush-treat the new wood with a wood preservative. Such a treatment has very little value because of the slight penetration of the preservative into the wood.

Another practice, which has been popularized by certain commercial agencies, is that of drilling holes into framing timbers already in place in buildings and attempting to force chemicals into such timbers for the purpose of controlling termites. This action may be justified where the timbers so treated are infested, as chemicals can be forced considerable distances through termite galleries; but such treatment in sound timbers of most wood species has been found to be a questionable practice, because of the cost and the weakening effect of a sufficient number of holes to effect a satisfactory treatment. Joints where wood meets wood and wood meets masonry may be washed with

*Illinois Lumber and Material Dealers Association, Inc., 919 Ridgely Building, Springfield, Ill.

a solid stream spray of wood preservative. However, it should be borne in mind by persons interested in the use of treated wood and wood preservatives that termites may build their protective galleries over treated wood to reach and feed upon untreated wood more distant from the soil. *Treated wood does not function as a termite shield.*

For the benefit of individuals who wish to make home treatments to wood such as fence posts, the following directions are offered from work of the U. S. Forest Products Laboratory.

Methods of wood treatment.*—Posts or other wood to be treated should be (1) peeled of all bark, (2) seasoned and dry, (3) free of decay and (4) cut to final form as nearly as possible.

Several chemicals are in use as wood preservatives. The one best adapted for treatment of fence posts, or other rough timbers not to be painted, is coal tar creosote meeting specifications of the American Wood Preservers' Association.

Creosote or creosote products are the cheapest and most economical materials available for effective home treatment of wood. The effectiveness of the treatment is in almost direct proportion to the amount of the chemical taken up by the wood. Creosote and creosote products are more readily absorbed than most other preservatives.

Brush treatment or spraying is the simplest method of application, although not the most effective. Hot creosote will penetrate better, and is therefore more desirable, than cold material. Two coats should be applied. Approximately 10 gallons of creosote for each 1,000 square feet of surface of rough lumber will be absorbed. Penetration will usually be less than one-sixteenth inch, and the life of the lumber or timber may not be extended more than 2 or 3 years.

Dipping lumber in a bath of creosote oil at 200 degrees F. for a short time (10 to 15 minutes), then removing the wood and allowing the excess oil to drain back into the tank is only slightly better than brushing.

The most effective treating method adaptable to farm conditions is the hot and cold bath process. The wood is heated to 210 degrees F. for several hours in a bath of creosote preservative. Then it is either quickly submerged in a bath of cold creosote for some time (long enough to cool) or allowed to cool

*Adapted from G. M. Hunt. Wood Preservatives, U. S. Department of Agriculture Forest Service, Forest Products Laboratory, in cooperation with the University of Wisconsin, Madison, Wis. February, 1933.

in the hot bath after the heat has been removed. This latter method is more easily employed than the first where only one vat is available, but it is slower. The temperature should not be allowed to rise above 220 degrees F., or some of the creosote may volatilize. Care must be taken that the creosote does not catch fire. The amount of penetration may be regulated to some extent by the length of time the wood is left in the bath. Sapwood is usually more easily penetrated than heartwood, and the amount of penetration and absorption will vary to some extent in different types of wood.

Soil and foundation treatments. All chemical preventives should be considered as supplementary to structural control of termites. Although the effectiveness of chemical treatments may last 5 to 8 years, it must always be kept in mind by the property owner that this period is a relatively short time in contrast to the life expectancy of an average building. The exact duration of such treatments cannot be given, as the durability of any one treatment will vary considerably with soil and climatic factors. Termite abundance will influence the rate of reinfestation of treated buildings and therefore the *apparent* effective duration of chemical preventives. The apparent lasting effect of some chemicals may be due in certain instances to absence of termites rather than to actual effectiveness of the materials.

Because the application of chemicals is resorted to as a stop-gap for some weakness in the design or oversight in the building process, from the standpoint of termite resistance, every effort should be made during construction to build against termites. Incidentally, almost every structural feature which adds resistance to termites aids also in preventing decay. Chemical control is of value chiefly in buildings beyond the construction stage. Even in buildings already built it is always best to eliminate contacts of untreated wood with the soil before proceeding with treatment.

Principles involved in chemical treatment. The principles involved in control of termites with chemicals are those mentioned in the section on structural control: (1) Subterranean termites must have access to moisture, which they usually acquire from the soil; (2) termites will not pass openly from soil to wood; they prefer to enter wood resting directly on soil, but they may attack wood removed from the soil by working up through voids in unit masonry foundations, by building covered galleries over exposed masonry foundations or, in unexcavated

areas, by building unsupported tubes to wood within 12 inches of soil.

In nearly all cases, infestations have their source in the soil contiguous with the floor or foundation, either inside or outside the building. Since termites move readily through the soil both horizontally and vertically, all foundation surfaces adjacent to soil are potential points of entry for these insects. Impervious masonry will not be damaged by the insects but may serve as a bridge for termite galleries between soil and susceptible wood. The more penetrable a foundation, the more encouragement it offers to termites, because of their preference for working through or into, rather than over, masonry supports. This preference, of course, emphasizes the need for solid masonry foundations and well-calked masonry joints. Since termites usually enter through or over foundation surfaces (where wood-soil contacts are not present), it follows that, if all soil immediately adjacent to foundations were repellent or poisonous to termites, the termite hazard would be removed. Establishing an effective barrier between the building and the insects is the goal of soil treatment with chemicals.

Methods of chemical treatment. –The methods of establishing a chemical barrier vary considerably with the type of foundation, types of concealed areas under porches or other parts of the building, soil type, climate and available equipment. The home owner attempting treatment of his property will necessarily have to resort to less refined or convenient methods of application than would a company specializing in termite treatment. For difficult situations special apparatus is necessary, and the services of a reliable pest control company should be secured. Whether treatment is made by the home owner or a commercial operator, the results will be the same if a thorough treatment is made. The specialized equipment of commercial operators tends to save labor and makes possible more thorough treatment under difficult conditions, but it is not necessary for simple situations.

Where termites are present and chemicals rather than structural features must be depended upon for control, the following procedure is suggested. Adaptations of this can be made for unusual circumstances.

1. All contacts between the soil and untreated (non-pressure-treated) wood should be eliminated and all visible termite galleries destroyed before chemicals are applied.

2. All soil adjacent to termite-penetrable walls, piers or masonry joints should be treated so that a layer 6 inches to 1 foot thick separates such potential points of entry from the untreated soil mass, figs. 17 and 18. Soil adjacent to impervious masonry foundations requires treatment only at top or where bridging may occur, fig. 19.

3. Soil beneath earth-filled terraces, porches and wood-

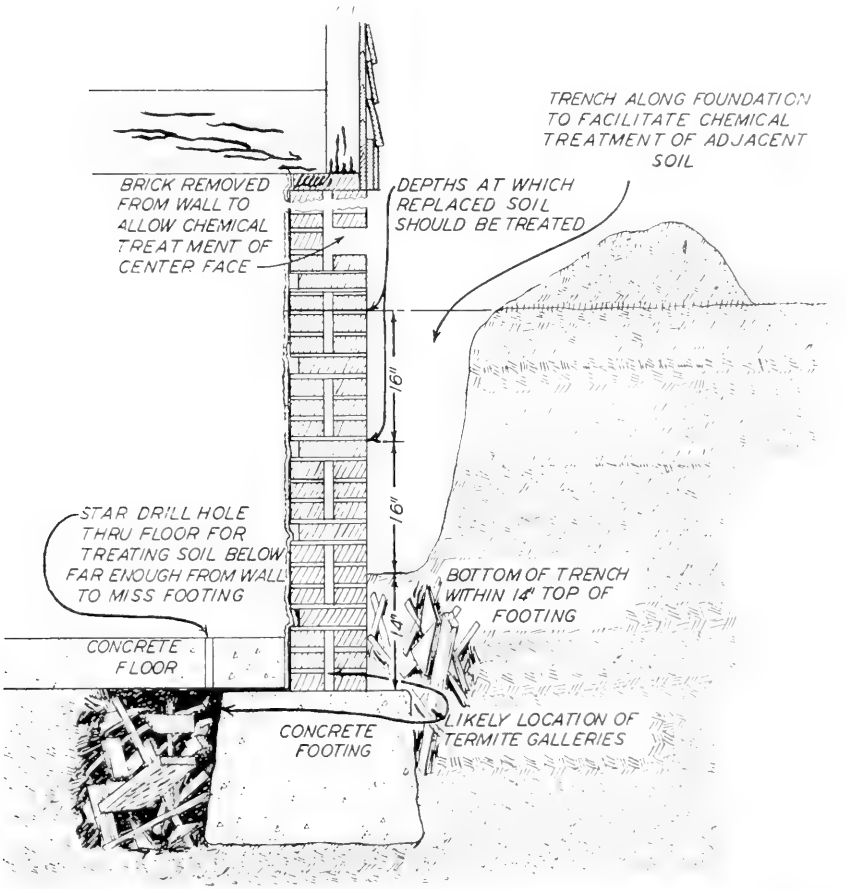

Fig. 19. -Details of points which should receive attention in the application of chemicals about a building for the control of subterranean termites. Every building offers some specific problems, but the principles involved are always similar to those shown here. The type of soil will influence the depth of the trench and the number of chemical applications necessary for thorough penetration. Clay soils require deeper trenching and a greater number of applications than more porous soils. Chemicals should not be applied to wet soil. It is important that the center openings, voids and cracks of the foundation receive attention.

covered, termite-penetrable masonry floors to be freed of termites should receive treatment adequate to form a repellent layer 6 inches thick adjacent to potential points of termite entry, fig. 19.

4. Cracks and openings in masonry walls, piers, foundations or floors should be treated with chemicals to destroy possible termite life within, fig. 19.

An important point to be remembered is that, after this type of treatment has been used about an infested building, those termites present in the structure above the ground line will soon die *if they do not have access to moisture above the soil.* However, they will attempt to construct bridging galleries back to the soil. These must be detected and destroyed. *All connections to other moisture must be broken.*

For home owners without special pumps or other pressure equipment, the simplest method of treating the soil is to trench along the foundation, fig. 19, and mix the chemical with the soil as it is replaced. If carefully done, this procedure will guarantee thorough treatment where the quicker, labor-saving methods of application may not. For the home owner attempting to pour chemicals into tight places, as beneath unexcavated buildings, a hose attached to a funnel will be found quite satisfactory. Elevation of the funnel end of the hose will cause the material to be delivered beneath the building. A cheap spray pump may also be used for simple home treatment jobs. Because oily materials destroy rubber washers, pumps with *leather* washers should be used for preservatives with an oil base. For chemicals that depend for effectiveness upon penetration of wall cracks and voids or holes drilled in concrete floors, time and the force of gravity usually aid considerably in giving adequate protection.

Thoroughness is necessary for the success of this work. For any foundation in which there is a possibility of termite penetration at many points, all soil contacting such a foundation must be treated. In the case of a solid foundation, treatment is necessary only at the top or near masonry joints. The soil type and the moisture content will influence the thoroughness with which the chemicals must be mixed in the soil as the latter is replaced in the trench. Fine-textured or clay soils require deeper trenching and more thorough mixing with chemicals than the more porous soils. Usually it is true that the drier the soil the more readily it absorbs the chemicals as they

are applied. It is usually unwise to attempt treatment of the soil when the ground is frozen.

Precautions.—Since practically all chemicals effective against termites will destroy plants with which they come in contact, precautions must be taken to avoid spilling these chemicals near grass or shrubs. When the trench method is used, valuable shrubs near the zone of treatment may be protected by tar paper or metal strips between the root system of the plants and the treated soil. The barrier should be placed against the side of the trench away from the building and left permanently.

Arsenicals are poisonous to man and animals and must be handled with care. They should not be used on soil where leaching into near-by surface wells might occur.

Fuel oil and some other organic compounds are inflammable, and their vapors mixed with air in certain concentrations are explosive. Open flames, therefore, should be eliminated when such materials are being used. The fire hazard of any mixture should be understood by persons using the mixture.

Chemicals to use for soil treatment.—There are a great many chemicals which have merit as soil poisons against subterranean termites. These materials may be divided into two general classes, as follows: the organic chemical compounds, usually oil-soluble; and the inorganic compounds, usually soluble in water and applied in solution. Such chemicals as trichlorobenzene, orthodichlorobenzene, tetrachlorophenol, pentachlorophenol, coal tar creosote, certain wood creosotes, chlorinated naphthalenes and chlorinated pentanes are all organic oil-soluble materials usually with some odor. Sodium arsenite and sodium arsenate are examples of inorganic chemicals soluble in water which have shown promise for soil treatment. They are odorless.

The choice of chemical should be governed by such factors as (1) the physical nature of the soil, (2) the chemical nature of the soil, (3) the fluctuation of the water table, (4) rainfall, (5) exposure to sun, (6) method of application, (7) cost, (8) the location of the infestation in the building being treated and (9) toxicity of the chemical to plants, animals and human beings. Many professional operators find it advisable to use two or three of the above chemicals on a single job to fit different situations. For example it may be desirable to use a water-soluble, odorless material inside the foundation, and outside where

leaching may occur to use an oil-soluble chemical more odorous but also more resistant to leaching.

Much remains to be learned by experiment about the "best" chemicals and the proper proportion of chemical to soil. It has been found, however, that a dispersing agent or carrier is necessary to aid in reaching all soil particles with the toxic chemical being used; in other words, thorough dispersion through the soil is necessary. Fuel oil is a satisfactory dispersing agent for the organic chemicals; water serves well in this capacity for the inorganic salts. Some of the chemicals permeate the soil more readily than others and this is sometimes a determining factor in selecting a chemical, especially where permeation is difficult to obtain.

Determining quantities of chemicals to be used.—Regardless of the chemical being used, it is necessary first to determine in cubic feet the volume of soil which will have to be treated to establish a barrier of treated soil at least 6 inches thick adjacent to the foundation (see "Methods of Chemical Treatment" and fig. 19). It is important that all the soil next to a termite-penetrable foundation be thoroughly treated.

The calculating of soil volume in termite control may be compared with the computing of a surface area to be painted. It is necessary in both cases to calculate the number of square feet of area to be treated. In the case of termite control, however, we are computing the volume of the layer of soil adjacent to that area of the foundation where termites may enter and we therefore must introduce the third dimension, which will give us cubic feet rather than square feet. It is simple, however, to convert square feet of surface area to cubic feet simply by multiplying the surface area by the width (in feet) of the soil layer. The following formulas may aid in computing volume of soil to be treated. All measurements should be in feet.

Formula for soil volume adjacent to line-wall foundations, each face being figured if treatment is necessary:

Length of foundation surface × Depth from ground line to footing × $^1_2$ = Volume in cubic feet of a soil layer 6 inches ($^1_2$ foot) thick adjacent to foundation

Formula for soil volume about piers:

Circumference of pier + 2 feet × Depth from ground line to footing × $^1_2$ = Volume in cubic feet of a soil layer 6 inches ($^1_2$ foot) thick adjacent to foundation

Additional treatment must be made under terraces, steps, grade-line doors or wooden floors on termite-permeable concrete.

A typical formula with an organic compound, trichlorobenzene, is as follows: Trichlorobenzene 2 parts, fuel oil 4 parts (by volume), the mixture to be used at the rate of 3 gallons per 10 cubic feet of soil.

A typical formula with an inorganic material, sodium arsenite, is as follows: Sodium arsenite 15 pounds, water 10 gallons, applied at the rate of 10 gallons of solution to 10 cubic feet of soil. If it is found that more than 10 gallons of water are necessary to wet 10 cubic feet of soil thoroughly, the 15 pounds of sodium arsenite should be dissolved in the total water necessary for this volume of soil.

Securing materials or services.—In purchasing chemicals for soil treatment it is usually wise to purchase on the basis of known chemical content. The home owner should beware of house-to-house soliciting by strangers selling services, inspections or "potent" chemicals of secret formulas. A thorough understanding of the termite problem and recognized methods of control as set forth in this circular should serve to aid in protecting the home owner against those companies or individuals not doing creditable work. In most communities well-qualified termite control service is available. An annual inspection for a nominal sum represents money well invested by the owner of susceptible buildings.

UNIFIED ACTION AGAINST TERMITES

Although it is possible for an individual in a city to eliminate all termites from his premises, termite control is a community problem. Cities should adopt adequate structural requirements to make new buildings termite resistant. It should be unlawful to sell termite-infested property knowingly, without informing the purchaser. The management of public institutions, as schools and churches, should instruct their caretakers or others responsible to be on the alert for termites. A constant vigil against termites may mean the saving of thousands of dollars to the home owners and other taxpayers in a community. The finding of termites need not be the cause for great fear or alarm, but definite steps should be taken to eliminate them as soon as they are discovered.

Recent Publications
of the Illinois Natural History Survey

A.—ILLINOIS NATURAL HISTORY SURVEY BULLETIN.

Volume 21, Article 2.—Responses of Large-mouth Black Bass to Colors. By Fran A. Brown, Jr. May, 1937. 23 pp., frontis + 10 figs., bibliog. 50 cents.
Contents: Problem of color vision in fishes; Materials for the experiments; Training an responses of large-mouth black bass; Interpretation of the responses; Summary.

Volume 21, Article 3.—Studies of Nearctic Aquatic Insects. By H. H. Ross and T. H Frison. September, 1937. 52 pp., frontis. + 86 figs., bibliog. 50 cents.
Contents: I. Nearctic alder flies of the genus *Sialis* (Megaloptera, Sialidae), by H. H. Ross: an II. Descriptions of Plecoptera, with special reference to the Illinois species, by T. H. Frisc

Volume 21, Article 4.—Descriptions of Nearctic Caddis Flies (Trichoptera), wi special reference to the Illinois species. By Herbert H. Ross. March, 1938. 84 pp frontis. + 123 figs., foreword, index. $1.00.

B.—ILLINOIS NATURAL HISTORY SURVEY CIRCULAR.

29.—Windbreaks for Illinois Farmsteads. By J. E. Davis. April, 1938. 18 pp., frontis. 12 figs.
Contents: Planning the windbreak; Planting the windbreak: Care of the windbreak; What t windbreak trees are like.

31.—The Peach Tree Borers of Illinois. By S. C. Chandler. February, 1939. 36 pp frontis. + 22 figs.
Contents: The peach borer: Peach borer life history studies: Control of the peach borer; T lesser peach borer: The peach bark beetle and the shot-hole borer.

32.—Pleasure With Plants. By L. R. Tehon. April, 1939. 32 pp., frontis. + 9 figs.
Contents: What is botanizing? Ways to botanize: Where to botanize: When to botanize: Ho to botanize: Studying plants; Equipment for studying plants: The herbarium: Useful book Maps; Conclusion.

33.—Controlling Peach Insects in Illinois. By S. C. Chandler and W. P. Flint. Augus 1939. 40 pp., frontis. + 32 figs.
Contents: Part I. Insects attacking bark and trunk of the peach tree—San José scale, pea borer, lesser peach borer, shot-hole borer and peach bark beetle, terrapin scale: Part Insects attacking twigs, foliage and fruit of the peach tree—oriental fruit moth, peach tw borer, plum curculio, tarnished plant bug, stink bugs, Japanese beetle, green June beet cotton leaf worm moth, aphids, grasshoppers, tree cricket, periodical cicada, thrips.

34.—Rout the Weeds! Why, When and How. By L. R. Tehon. August, 1939. 47 pp., col frontis. + 13 figs.
Contents: The importance of weeds: Weeds as economic factors: Weeds as harborers of insect Weeds as harborers of plant diseases; Relation of weeds to public health; Control method Thirteen noxious and pernicious weeds of Illinois—European bindweed, perennial sow thist Canada thistle, common ragweed, western ragweed, lance-leaved ragweed, giant ragwee poison ivy, poison sumac, wild parsnip, white snakeroot, pokeweed, common burdock.

35.—Diseases of Small Grain Crops in Illinois. By G. H. Boewe. September, 1939. 1 pp., frontis. + 47 figs.
Contents: Nature of cereal diseases; Wheat diseases: Oats diseases: Barley diseases: R diseases: Cereal disease control.

36.—Planting and Care of Shade Trees. By J. E. Davis. March, 1940. 23 pp., frontis. 16 figs.
Contents: Introduction: Planning for shade: Planting shade trees: Care of newly planted tree Some common trees used for shade.

C.—ILLINOIS NATURAL HISTORY SURVEY MANUAL.

1.—Fieldbook of Illinois Wild Flowers. By the staff. March, 1936. 406 pp., col frontis. + 349 figs., index. $1.50.
Contents: Introduction: Key to families: Description of species (650).

2.—Fieldbook of Illinois Land Snails. By Frank Collins Baker. August, 1939. 166 pp color frontis. + 170 figs., 8 pls. $1.00.
Contents: Land snails: what they are and where they live: Land snails native to Illinois: La snails introduced from foreign countries: Land snails of uncertain presence in Illinoi Bibliography: Check list of Illinois species: Index.

List of available publications, over 300 titles, mailed on request.

Address orders and correspondence to the Chief

ILLINOIS NATURAL HISTORY SURVEY

Natural History Bldg., Urbana, Ill.

Payment in the form of U. S. Post Office money order made out to State Treasurer of Illinois, Springfield, Illinois, must accompany requests for those publications on which a price is set.